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LIGHTING DATA

EDISON LAMP WORKS
OF GENERAL ELECTRIC COMPANY

GENERAL SALES OFFICE HARRISON, N. J.

Street Lighting with MAZDA Lamps

Information Compiled by

R. E. GREINER

Lighting Service Department

SYNOPSIS:

For information regarding MAZDA lamps and lighting questions, refer to the nearest sales office as listed on the last page of this bulletin.

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Purpose of Street Lighting

Originally, the chief function of street lighting was the prevention of crime. Throughout the eighteenth century, it was worth a person's life to travel the streets of any large city without a bodyguard. Even during the last generation there have been certain sections in many American cities dangerous to traverse after nightfall. Good street lighting has practically done away with this undesirable condition, so much in fact, that one is likely to forget the fundamental purpose of street lighting.

It is interesting to note that after a high intensity White Way system of lighting was installed on the main business streets of Cleveland, a decrease of 8 per cent was observed* in the number of crimes taking place, when on the more poorly lighted streets there was an increase of 57 per cent. Obviously, street lighting is still a very important and necessary factor in crime prevention.

While later requirements may, in one sense, be considered as secondary to that of crime prevention, they have actually demanded much higher levels of illumination.

Another reason for street lighting which has always been more or less apparent, even in the early practice, is the facilitation of traffic. With the rapidly increasing amount of high speed automobile traffic, good illumination becomes more and more essential, not only on city streets but likewise on suburban highways where street lighting was not formerly economically practical. From an observation† extended over about thirty of our principal cities, it is shown that out of 10,640 killed in traffic accidents, in 1920, 3223 deaths occurred in night accidents, 17.6 per cent or 567 which could be attributed to lack of sufficient illumination. Dr. Crum, Statistician of the Prudential Insurance Company states‡ the annual street accident loss to be fully one billion dollars and he further estimates that fifty-four million dollars of this loss is caused by lack of light. In contrast to this, it is startling to note that the total amount spent annually for street lighting in the United States, according to census reports, is not in excess of fifty million dollars. In view of the above, a far greater amount could well be invested

* Statistics on Street Lighting and Crime in Cleveland, Ward Harrison, Trans. I.E.S., Vol. 16, page 463.

† Illumination and Traffic Accidents, E. A. Anderson and O. F. Haas, Trans. I.E.S., Vol. XVI, No. 8.

‡ F. S. Crum paper—Automobile Fatalities.

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in additional street lighting and yield a splendid return in the reduction of the accident loss which now prevails.

It has been definitely proved that lighting by modern methods actually does reduce crime and prevent accidents, that unfortunately these systems are employed to a relatively small extent, and that it is economically desirable to extend such lighting for both congested areas and highways as rapidly as possible.

A third function of street lighting which is of recent origin and which demands an even greater amount of illumination than required to prevent crime and accidents, is the advertising or attracting power of the so-called White Way system of illumination. High intensity street lighting of this nature has sprung from small beginnings. At the outset such ornamental lighting consisted of temporary installations for gala occasions. These were found to be so successful from an advertising standpoint in stimulating activity in the business section and generally increasing the attractiveness of the cities, that permanent White Way installations are now demanded for the more important sections of both large and small cities.

That improved street lighting is really needed over the entire country seems obvious. That it is economically practical if properly designed has been established by the experience of many progressive cities and towns.

It is the purpose of this bulletin to give information regarding the selection of proper equipment and installation of MAZDA lamps so as to best meet the requirements of the various classes of street lighting.

Principal Business Sections

General Requirements

As the commercial life of a community is centered in its retail business district, the illumination here should be of the highest order, which has given rise to the so-called White Way lighting. The installation should be such that it will provide:

1. A high intensity of illumination to attract the crowd, increase business and to prevent accidents from the dense traffic.

2. Quality with regard to color, diffusion of light and freedom from glare.

3. A distribution so controlled as to give sufficient illumination on the street surface and at the same time allow enough light to strike the building fronts and make visible the architectural details.

4. Units of such a character as to present an attractive appearance both by day and night and harmonize with the character of the buildings and carry out the traditions of the community.

A distinctive characteristic of White Way lighting is that more illumination is demanded between street intersections than on the corners themselves, whereas in all other classes of street lighting, the maximum is required where the lines of traffic cross. The reason for this is that the publicity and decorative functions call for more light than would be required for reasonably safe travel.

Type of Units

White Way lighting for the business section demands the use of the ornamental types of fixtures or luminaires. (Fig. 1-A-B-C-D and E.) These units are provided with diffusing glass globes of various designs surrounding the light source to break up the light given out by the bare lamps. In this way glare which would otherwise be present is eliminated. The entire globe becomes the apparent source of light and because of its comparatively low brightness makes for greater eye comfort both for pedestrians and vehicular traffic and helps beautify the streets.

Such units ordinarily do not materially change the distribution of light given by the lamp itself as indicated in Fig. 3. Hence, this type of lighting, while allowing plenty of light on the street surface, sends illumination to the structures which are along the street to cause them to stand out. Thus the street appears to be more luminous than if the light were sent to the street surface only.

This diffusing glassware may be obtained in several varieties. Opalescent and rippled glassware are the most widely used. The opal glass affords a uniform brightness over the entire globe while the rippled glass, by its slight refracting properties, gives a certain sparkle or animation to the illumination and at the same time permits more or less control of the distribution to meet particular conditions.

Condition of Surroundings and Method of Mounting Units

Single units, such as pictured in Fig. 1, are recommended because of the higher efficiency which is obtained with one large lamp than with a group of small lamps. In the large cities, however, it is often desirable to install two or more such units on one standard to make an intensive or super-white way. These can be mounted as pictured in Fig. 2, which also shows schemes for mounting single units.

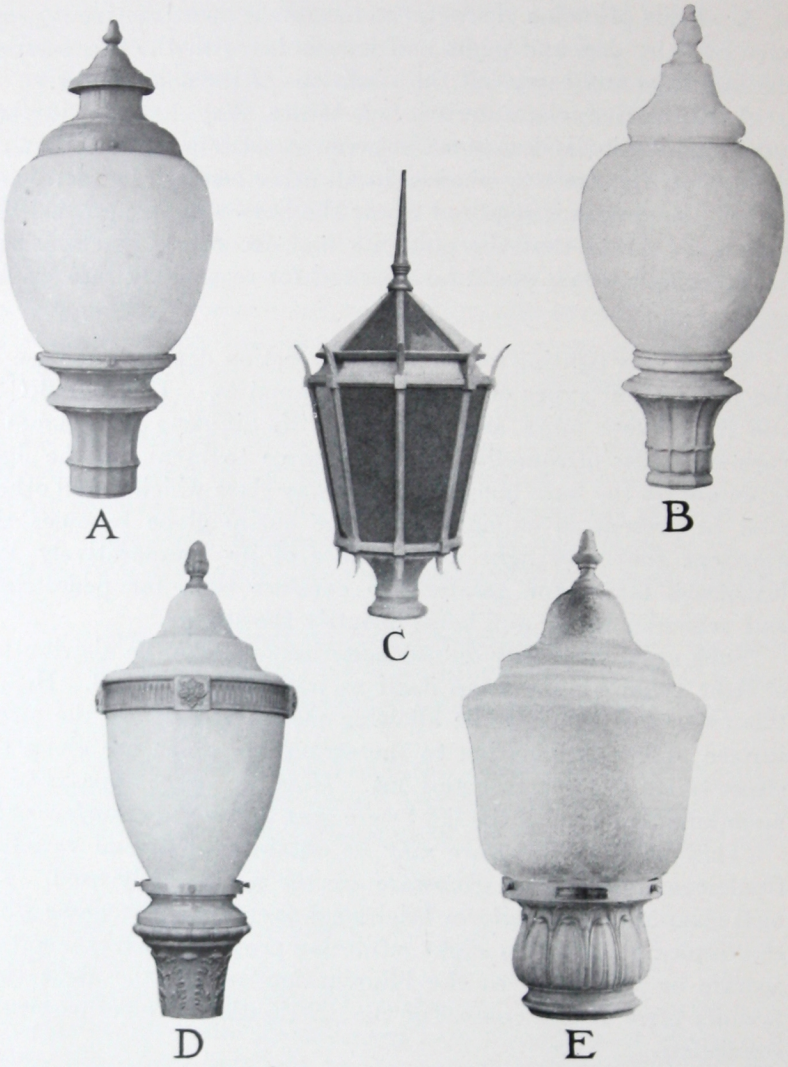

FIG. 1

Typical Ornamental Luminaires for White Way Lighting Available for Use with MAZDA C Lamps of the 2500-, 4000-, 6000-, 10,000-, 15,000- and 25,000-Lumen Rating

A—Form 16 Novalux, consisting of opalescent glass enclosing globe and metal canopy.

B—Form 13 Novalux, with opalescent glass enclosing globe and glass canopy.

C—Form 18 Novalux ornamental lantern type with diffusing panels of cathedral glass equipped with dome refractor.

D—Form 12 Novalux ornamental unit consisting of an opalescent glass globe, glass canopy and decorative metal casing.

E—Form 9 Novalux ornamental unit consisting of alabaster rippled glass globe and canopy equipped with dome refractor.

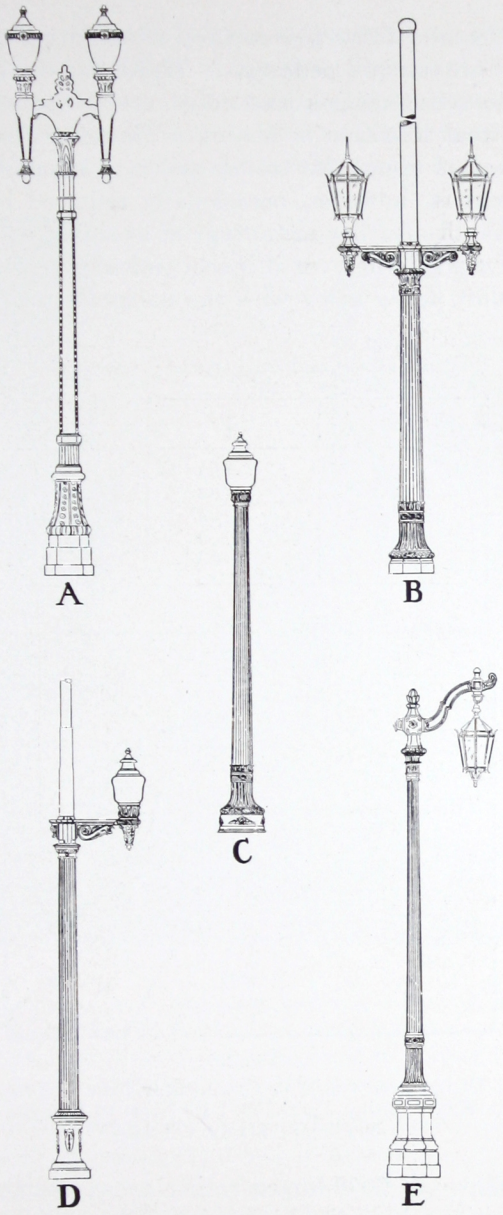

FIG. 2

Methods of Mounting White Way Luminaires

A—Specially designed ornamental two light standard with Novalux Form 12 ornamental luminaire.
B—Trolley pole twin bracket type with Novalux Form 18 ornamental lantern type luminaire.
C—Ornamental standard for single light with Form 9 Novalux luminaire.
D—Single light ornamental bracket for trolley pole mounting with Novalux Form 9 luminaire.
E—Ornamental mast arm mounting with Novalux Form 19 ornamental lantern type luminaire.

Perhaps the most attractive method of mounting the luminaires is to employ ornamental pedestals. These can be obtained in a number of beautiful designs and often are so made as to incorporate some local tradition or history. The somewhat more economical method of using the trolley poles to support ornamental bracket fixtures is, however, occasionally required by local conditions, and has the further advantage of avoiding a multiplicity of poles. The wiring, wherever it is economically practicable, should be underground, doing away with the unsightly overhead system.

Size and Spacing of Lamps

Approx. Size of City	SIZE OF LAMP		Mounting Height	Spacing
	Lumens	C-P.		
Up to 15,000....	6,000	600	14 ft.	60– 80 ft.
15,000 to 250,000	10,000	1000	18 ft.	80–100 ft.
250,000 and up..	15,000	1500	18 ft. – 22 ft.	100–125 ft.
	25,000	2500	22 ft. – 25 ft.	100–150 ft.
	10,000	*2–1000	15 ft. – 22 ft.	100–150 ft.

* 2-light standard.

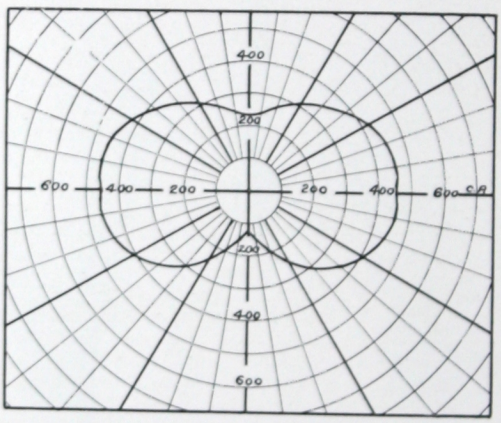

FIG. 3

Typical Vertical Distribution Curve of Ornamental Type Diffusing Luminaire for White Way Lighting. Unit (Fig. 1-D) Form 12 Novalux with 6000-lumen MAZDA C Lamp

Lamps below the 6000-lumen rating are recommended only in the smaller cities where the higher intensity of light is not practicable.

The actual spacing of units is governed by a number of considerations. An even distribution of light upon the street surface would be desirable, but it has been found that the advantages

gained by having this even intensity are not enough to offset the added cost of the lighting equipment necessary to produce it. Good practice in planning a street lighting system is to have the ratio between the maximum intensity and minimum intensity not greater than 15 to 1, the economic limit being about 3 to 1. Any ratio

FIG. 4
A White Way Installation in a Large City (Los Angeles, Cal., population 580,000)
Two Form 12 Novalux with 10,000-lumen MAZDA C lamps are mounted on ornamental poles of special design, height, 25 ft.; spacing, 75 ft. on both sides of the street, opposite

between these two limits is considered relatively uniform lighting, a high standard of uniformity being a ratio of 5 to 1.

Another factor which must be taken into consideration is the width of the street. In lighting streets of ordinary width it is common practice to utilize a row of lighting units on each side of the street. This arrangement gives a proper distribution of light and a desirable uniformity of appearance. The units are mounted either opposite or staggered, the staggered system not being as

satisfactory as the opposite type for very wide streets. The staggered system gives very good results on streets not wide enough to warrant installing units opposite or narrow enough to use simply one row. The appearance of uniformity is in this way maintained and a much more effective distribution of light is obtained which offsets the added cost of installation.

Again, the spacing may be affected by local conditions such as length of the blocks, location of trolley poles and the like. It is also important to note that, for a given spacing, the cost of street

FIG. 5
Night View of a White Way in a Large City (Newark, N. J., population 420,000) Lighted by Form 6 Novalux Luminaires with 15,000-lumen MAZDA C Lamps on Ornamental Trolley Pole Brackets. Height, 22 ft.; spacing, 120 ft. on both sides of the street, opposite

lighting does not usually increase nearly so fast as the size of units. Not only are the larger lamps more efficient, but the overhead costs almost invariably become a relatively smaller factor for the larger lamps.

Typical installations of White Way luminaires are pictured in Figs. 4, 5 and 6.

Secondary Business Section

General Requirements

This classification includes the less important business streets adjacent to the main business street and those smaller business centers which spring up in semi-suburban districts of all cities.

On these streets, it is obvious that the intensity of illumination will be somewhat lower than on the principal business section. It should, however, be of a comparatively high standard.

There is not the same demand for the publicity element, and traffic is not likely to be so heavy on this class of street, making a slight decrease in illumination possible without increasing the number of accidents. There will still be provided ample illumination for the prevention of crime.

FIG. 6

White Way Lighting in a Small City (Lancaster, Ohio, population 15,000). Novalux Form 12 luminaires on ornamental pedestals with 2500-lumen MAZDA C lamps. Height, 13½ ft.; spacing, 100 ft. both sides of street, opposite

Type of Units

In general, the ornamental system should be continued to preserve the uniformity of appearance. It is, however, sometimes necessary to allow a somewhat wider spacing or smaller lamp, or to use a more economical method of lighting. In this case, a pendant type unit with diffusing globe (Fig. 7-A and B) would be recommended. Refracting equipment is generally desirable with either type of luminaire, especially if the spacing is fairly wide.

Because of development of refracting equipment, the distribution of light from street lighting luminaires can be quite accurately

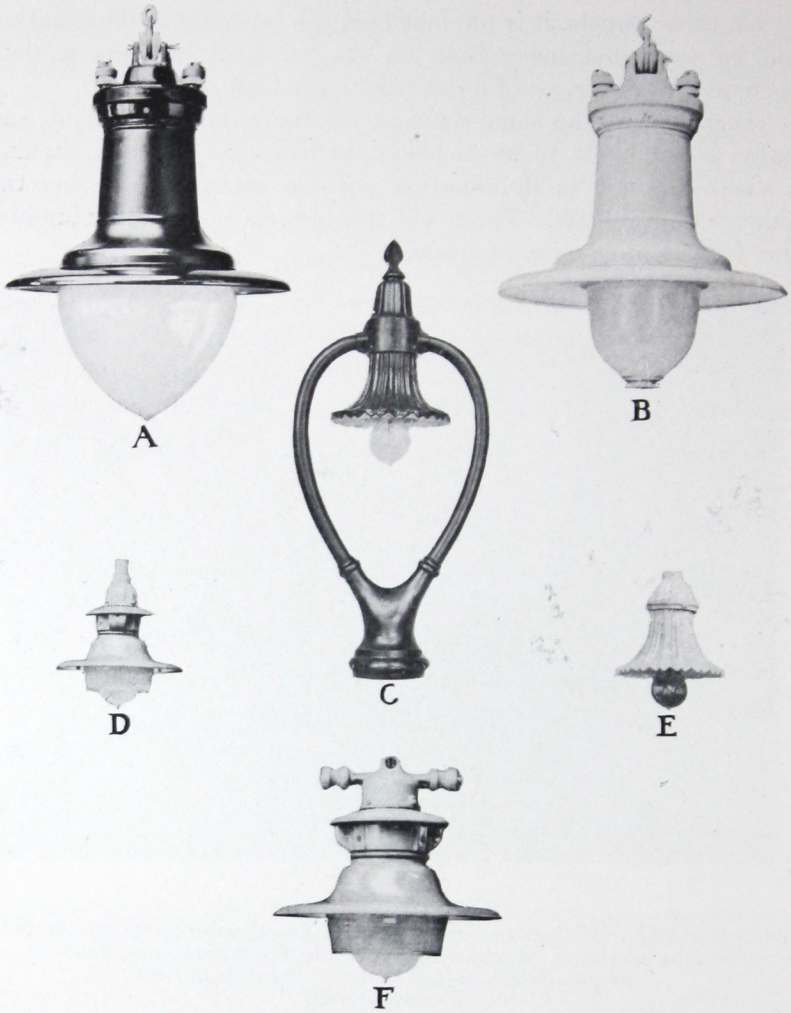

FIG. 7

Typical Pendant Luminaires for Large Size Lamps and Equipments for Smaller Sizes

A—Form 6 Novalux luminaire with opalescent glass diffusing globe and porcelain enameled steel reflector for MAZDA C lamps from 2500 to 10,000 lumens.

B—Form 6 Novalux luminaire with bowl refractor and porcelain enameled steel reflectors for lamps from 2500 to 10,000 lumens.

C—Form 17 Novalux unit with porcelain radial wave reflector and harp mounting. Lamp sizes, 1000 to 2500 lumens.

D—Bracket type luminaire with band refractor. Lamp sizes up to 4000 lumens.

E—Eternalite bracket type luminaire with porcelain radial wave reflector. Lamp sizes, 1000 to 2500 lumens.

F—Center span type luminaire with band refractor. Lamp sizes up to 4000 lumens.

controlled to give the maximum candle-power at any desired angle. This is ordinarily 10 to 15 degrees below the horizontal. The directional effect is secured by means of a prismatic glass refractor, the prisms being so designed as to refract the light given off by the lamp into the desired direction.

The various forms of refractors are shown in Fig. 8. Some indication of the manner in which refractors control the light distribution can be gained from a comparison of Figs. 3 and 9.

Conditions of Surroundings and Method of Mounting Units

The buildings lining the secondary streets are not so high as along the main business section and the streets are somewhat narrower. In mounting the units, if the ornamental type is used, the same

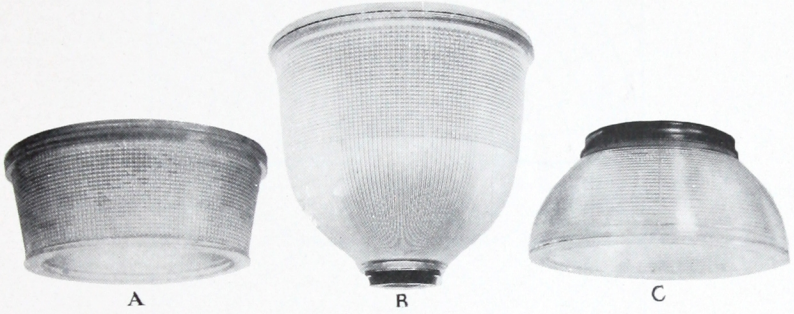

FIG. 8

Prismatic Glass Refractor for Street Lighting

A—Band refractor for lamp sizes from 1000 to 10,000 lumens.
B—Bowl refractor for lamp sizes from 1000 to 10,000 lumens.
C—Dome refractor for lamp sizes from 1000 to 10,000 lumens.

style standards are employed as on the main business street with a wider spacing or a somewhat lower mounting height and smaller lamp. In the case of the pendant type unit, it is mounted on a mast arm and swung out over the street (Fig. 10-C) or on the so-called "Bishop's Crook" bracket (Fig. 10-B).

Size and Spacing of Lamps

Type of Unit	SIZE OF LAMP		Spacing	Mounting Height
	Lumens	C-P.		
Ornamental	4000–6000–10000	400–600–1000	100–125 ft.	13–18 ft.
Pendant	4000–6000–10000	400–600–1000	100–125 ft.	15–20 ft.

A typical installation on a secondary business street is pictured in Fig. 11.

Main Thoroughfares

General Requirements

These comprise main routes through the city and are, therefore, subjected to a heavy flow of high speed traffic. In this case, a high intensity of illumination is needed to insure safety. As much light as is actually provided on the streets in the main business section is desirable. However, here the buildings need not be so well illuminated and the same illumination on the street itself can be obtained at a lower cost by directing the light so that it is used more effectively, rather than using the diffused system which lights up the surroundings. Some sort of refracting equipment is essential to accomplish this end.

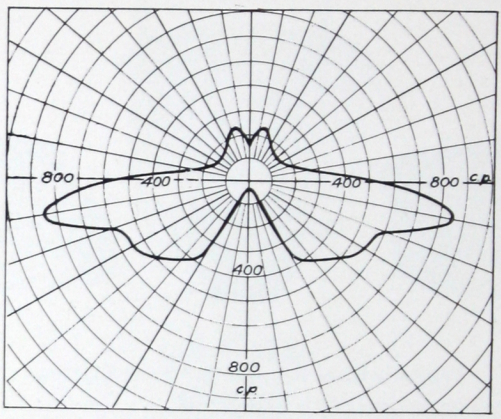

FIG. 9

Typical Vertical Distribution Curve of Form 9 Novalux Ornamental Type Luminaire for White Way Lighting with Dome Refractor Unit (Fig. 1-E) with 6000-lumen MAZDA C lamp

When these thoroughfares traverse the better residential sections, a neat and attractive unit is necessary and an ornamental system is desirable.

Type of Unit

As mentioned above, the prismatic refractor is invaluable in this type of lighting permitting a wider spacing of units and economical operation.

In choosing a unit for this character of street, careful consideration must be given to the distribution of light which it affords. It must direct the illumination to the street surface as this class of

thoroughfare is lined for the most part with residences set back from the street and comparatively little illumination should be sent to the buildings.

Economic considerations will govern the choice of the equipment. Pendant (Fig. 2-E) or mounted (Fig. 1-E) types as used on the business streets equipped with refractors are desirable. Effec-

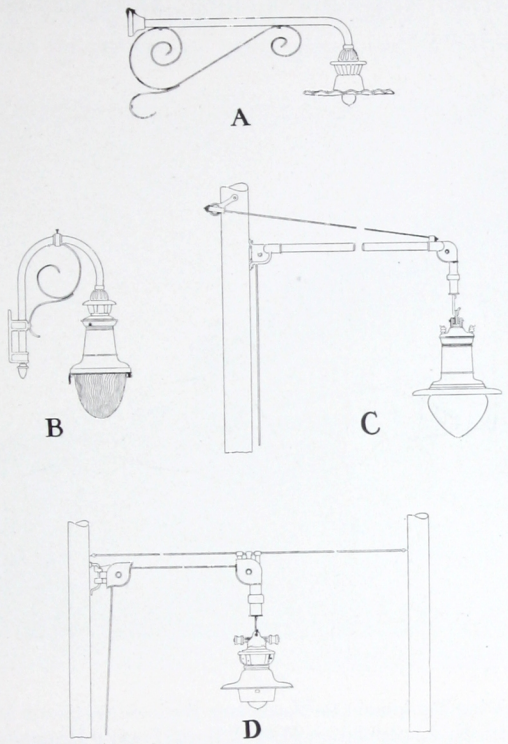

FIG. 10

Methods of Mounting Pendant Units

A—Bracket type suspension with porcelain enameled steel radial wave reflectors.
B—Bishop's Crook bracket with Form 6 Novalux pendant unit.
C—Mast arm suspension with Form 6 Novalux and lowering device.
D—Center span type suspension with lowering device.

tive installations, though not of the same artistic standard, can be obtained through using the pendant luminaires such as shown in Fig. 7-B and 10-B.

Conditions of Surroundings and Method of Mounting

Here little or no reflection is obtained so that to secure the proper distribution and protect the eye from the light sources

viewed against the dark background a higher mounting should be used. Frequently, trees are encountered which necessitates placing of lighting units on some form of mast arm (Fig. 10-C) which carries them over the street clear of foliage.

Units should be arranged along one side of the street except where the thoroughfare is of exceptional width, when each side should be provided with a row of units. These may be placed either opposite or staggered.

FIG. 11

Day View of Lighting Equipment for Secondary Business Section in Medium Size City (Atlantic City, N. J., population 51,000) Using Form 9 Ornamental Novalux Luminaire with Alabaster Rippled Glass Diffusing Globe and Dome Refractor. Lamp size 4000 lumens, height of light source, 12 ft.; spacing, 150 ft., staggered

Size and Spacing of Lamps

Kind of Units	SIZE OF LAMP		Spacing	Mounting Height
	Lumens	C-P.		
Pendant.....	4000-6000-10,000	400–600–1000	100–200 ft.	15–20 ft.
Ornamental.....	4000-6000-10,000	400–600–1000	100–150 ft.	15–20 ft.

Fig. 12 shows a typical installation of modern equipment on a main thoroughfare.

Residence Streets (Exclusive of Main Thoroughfares)

General Requirements

The requirements of residential street lighting vary considerably. The main consideration in this section is to provide illumination of sufficient intensity to discourage criminal activities. Vehicular traffic in this area is of secondary importance because of its sparseness. Sufficient light should be furnished, however, to enable passersby on the street to recognize each other conveniently. To obtain

FIG. 12

Main Thoroughfare (Houston, Texas) Lighted by Novalux Form 8 Ornamental Luminaire with 4000-lumen MAZDA C Lamps spaced approximately 150 ft. apart, staggered. Height of light source, 15 ft.

these results, the light must be fairly uniformly distributed and free from dense shadows.

Type of Units

In general, pendant type fixtures (Fig. 7-A -B -C -D -E and F) are used for residence street lighting, although it would be equally desirable to use an ornamental type fixture. By the use of refracting equipment with the various types of units, the streets can be illuminated quite well with wide spacings except where dense foliage prevails.

As pointed out in the next section, local conditions sometimes make necessary the use of small lamps. These are well served when using a type of equipment known as a "radial wave" reflector. This is either of porcelain enameled steel or pressed porcelain with flutings as pictured in Fig. 10-A and 7-C and -E. Its flat contour directs light at a wide angle (see Fig. 13) although it does not control the distribution to the same degree as a refractor.

Condition of Surroundings and Methods of Mounting.

Ordinarily a residential street has along each side a row of trees which makes it a hard problem to get illumination upon the

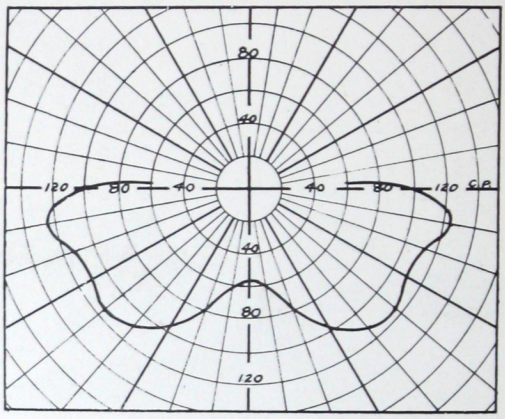

FIG. 13

Distribution Curve Form 17 with 1000-lumen MAZDA C Lamp, showing wide distribution and minimum of light in the upward direction

street surface as uniformly as desired, because of the dense foliage. It is a common practice to mount rather large lighting units of the type pictured in Fig. 10-C and D at each street intersection, light from these units being sent in each direction down the intersecting streets. This gives the most light at the street corners where there would be more likelihood of traffic accidents. Extremely long blocks, however, cannot be lighted simply by having one light at each corner as this would leave the central part of the block almost in total darkness, even though refractors were used to widen the distribution of light. To overcome these difficulties one or two units should be placed along the street between intersections so mounted as to eliminate interference by foliage. On the older residential streets the trees are for the most part of considerable size, usually trimmed quite high, allowing lighting units

to be placed below the branches. Thus practically no useful illumination is lost in the foliage. On the newer streets, the trees are apt to be quite young with the branches starting seven or eight feet from the ground. Here much trouble occurs because of the units coming among the branches. This results in a serious absorption of the light by the foliage. To overcome this, the lamps must be mounted on mast arms, Fig. 10-C, and swung out beyond the

FIG. 14
This Day View Shows a Typical Residential Street (Rochester, N. Y.) Well Lighted with Novalux Form 17 Luminaires, carrying 2500-lumen MAZDA C Lamps on approximately 150-ft. spacings, staggered. Height of light center, 12 ft.

trees to clear the branches, or smaller units mounted at a lower height more closely spaced can be utilized.

Most cities have realized that by allowing the forestation along the street to reach such a magnitude that it seriously affects the illumination they are not allowing the proper lighting of their streets and have, therefore, passed ordinances compelling residents along the street to trim their trees up to a certain height. Other cities have gone a step further and have hired competent men to take care of this work under the supervision of the park department.

Considerable care must be taken in residential street lighting so as not to place the lighting units where objectionable light will be thrown on to the houses. A great deal of trouble has been experienced in this way, causing considerable expense in changing units from one position to another. Little annoyance will be caused, however, if the light is so distributed as to allow no illumination to strike higher than the first story of the residences.

FIG. 15

Typical Residential Street (Newburgh, N. Y.) Lighted by Novalux Form 6 Luminaire with Bowl Refractor. Lamp size, 6000 lumens, suspended at each street intersection approximately 20 ft. mounting height

Size and Spacing of Lamps

Kind of Units	SIZE OF LAMP		Spacing	Mounting Height
	Lumens	C-P.		
Pendant (at corners)	2500–4000–6000	250–400–600	200–350 ft.	15–20 ft.
Pendant (more closely spaced)	1000–2500	100–250	100–200 ft.	10–18 ft.
Ornamental	1000–2500–4000	100–250–400	100–250 ft.	10–16 ft.

Fig. 15 shows an installation of large units mounted at the street intersections, while Fig. 14 shows the use of small units so placed as to avoid loss of light in the foliage.

Parks

General Requirements

Park lighting is a phase of outdoor illumination which is of considerable magnitude and a necessary element of park planning. The walks and roadways in parks should not be so brilliantly lighted as a street proper, except in cases of heavily traveled thoroughfares within the park area. A certain sense of duskiness

FIG. 16

A Well Designed Park Lighting System (Congress Springs Park, Saratoga Springs, N. Y.) using Novalux Form 12 Ornamental Luminaire with Specially Designed Ornamental Lighting Standard. Lamp size, 2500 lumens, various spacings to conform with park outlines

within a park is very desirable on a summer evening and can well be allowed in so far as may be found to be compatible with maintaining order.

Kind of Unit

It is a foregone conclusion that, in a park which is to be developed to the highest artistic standard, appurtenances of the park should be designed for beauty of individual detail. In the development of parks in foreign cities, even the receptacles for waste paper are designed conscientiously. Lighting standards even more should exhibit intelligent design, pleasing in proportion and lines. Much

has been accomplished in park lighting in the last few years but there is still room for a great deal of improvement. Good practice in park lighting demands ornamental fixtures. These may be obtained in different forms which harmonize well with the various park designs. One very effective design of lighting unit is in the form of a lantern, either mounted on a pedestal or suspended from an ornamental mast arm (Fig. 1-E). Other types such as illustrated in Fig. 1-D and E make very desirable means of illumination for this purpose, both the diffusing and refracting types of luminaires finding application.

Surroundings and Method of Mounting

The placing of the lighting standards should be determined with regard to an even distribution of light and at the same time with reference to the lines of the park design. It is obvious that lighting standards should not be so placed as to interfere during the day with view or vista and thus become a distracting element in the park design. In formal parks, in fact, they may be made to serve as a very helpful accent to the design and should be used for this purpose by the park designers much as ornamental fixtures are used by architects in the composition of the buildings. Ornamental standards may be obtained in various designs to fit in with the different classes of landscape architecture.

Size and Spacing of Unit

Type of Unit	SIZE OF LAMP		Spacing	Mounting Height
	Lumens	C-P.		
Ornamental with refractors	2500–4000–6000	250–400–600	100–200 ft.	12–20 ft.

Fig. 16 shows a park installation of diffusing units of medium size mounted on a unique type of post which embodies local traditions.

Boulevards

General Requirements

Every city prides itself on having one or more stretches of well-paved streets through the best section of the town, providing a promenade for automobilists. These streets, or boulevards as they are called, are very popular with car owners, and in consequence there is a heavy flow of traffic, particularly in the evening.

To provide safe conditions on the boulevard requires a high level of illumination. Enough light should be provided to eliminate the necessity of bright headlights on the cars. In this way, the great nuisance of glaring headlights is avoided. The driver can readily discern objects in his path, and is able to see accurately and quickly, thereby reducing accidents to a minimum. Traffic is also handled much more readily and speedily under the higher intensity of illumination, which increases the capacity of the boulevard.

FIG. 17
An Outlying Section of a City (Newburgh, N. Y.) Lighted by Bracket Type Radial Wave Steel Luminaire with Porcelain Reflecting Surface. Size of lamp, 1000 lumens, spacing, 250 ft.

Type of Unit

The lighting of boulevards is accomplished with some form of ornamental unit in keeping with the character of this class of street. In some cases, a pendant type unit with diffusing globe has been used. Several new ornamental designs of this character are now available. (Fig. 1-D and -E and Fig. 2-E.)

Conditions of Surroundings and Method of Mounting Units

In regard to the locating of the light sources, it is found that these streets generally require a row of units hung or mounted along

either curb. Some boulevards of a more formal character have a narrow parkway through the center of the street. Under these conditions, the lighting units may be mounted in a single row along the parkway. This arrangement is economical of light and very good results have been obtained.

Size and Spacing of Lamps

Type of Unit	SIZE OF LAMP		Spacing	Mounting Height
	Lumens	C-P.		
Ornamental	4000–6000	400–600	100–150 ft.	15–20 ft.
Pendant	4000–6000	400–600	100–200 ft.	20–25 ft.

Outlying Suburban Sections, Alleys and Side Streets

General Requirements

In the thinly settled residential sections in the suburban districts, street lighting becomes mainly an economic problem. The houses are spaced quite widely with sometimes a whole block left vacant. It is evident, however, that all these streets must be lighted to provide safe conditions for those persons living beyond and around these unsettled areas. Future developments also require that some light be furnished.

An often overlooked consideration in street lighting is that of illuminating alleys and unimportant side streets. Insufficient attention is paid to this class of lighting, making these byways a menace to public safety. That some light should be furnished is quite evident. A high intensity is not practicable or necessary. Enough illumination should be provided, however, to eliminate dense shadows and make patroling convenient.

Type of Unit

To accomplish the lighting of these streets satisfactorily, a lighting unit of low cost must be used. A wide distribution of light must be obtained to require as few units as possible. The unit itself should be of the bracket type for streets or center suspension for alleyways. A porcelain radial wave reflector (Fig. 7-E) meets the requirements very well. The reflecting surface is non-deteriorating and has a high reflective power, redirecting the upward rays of the lamp back to the street surface. The long life of this sort of fixture tends to make it quite popular for this form of lighting. Then, too,

as the outlying districts are built up, the brackets may be replaced by larger units and moved further out and again put into use. Steel reflectors (Fig. 10-A) with a white porcelain enameled reflecting surface are also used quite extensively for this class of street.

Size and Spacing of Lamps

Type of Unit	SIZE OF LAMP		Spacing	Mounting Height
	Lumens	C-P.		
Porcelain or steel radial wave	1000	100	50–100 ft.	12–15 ft.
Dome radial wave	1000–2500–4000	100–250–400	100–150 ft.	13–20 ft.
Band refractor types	1000–2500–4000	100–250–400	100–300 ft.	15–22 ft.

NOTE.—Lamps of less than 1000 lumens output are not generally economical for street lighting.

Fig. 17 pictures the simple, yet fairly effective type of lighting for this class of service.

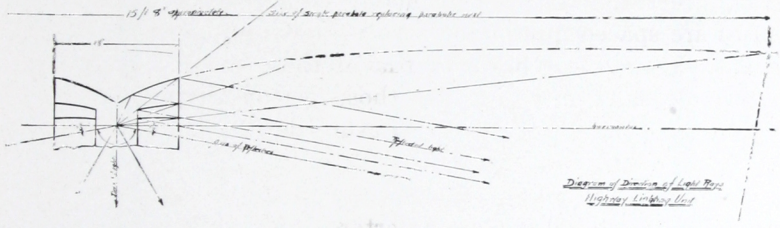

FIG 18
Drawing Showing Direction of Light Rays as Controlled by Novalux Highway Lighting Unit

Highway

General Requirements

The ever-increasing amount of traffic over our main highways has so congested them that the need of some means of relief has become acute. The number of cars on some of our Metropolitan highways has swelled to such a volume that there is a continual procession of automobiles, especially during the evening hours, and, while the number of vehicles upon the highways has increased so materially, the capacity of the highways has remained practically constant.

As a direct result of this congested condition, there has been a considerable increase in the number of serious accidents happening upon our main highroads. Precautions have been taken to protect

the traveling public by posting all sharp curves, narrow bridges, steep grades and the like. The protection afforded by this means does not, however, extend adequately beyond the hours of daylight when the automobiles have to depend entirely upon their

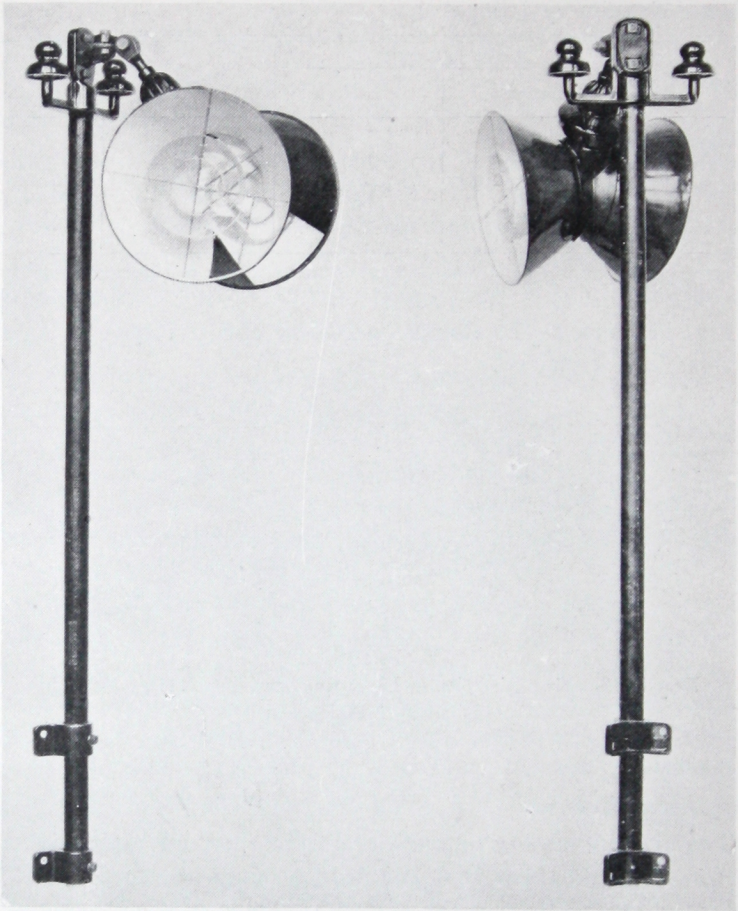

FIG. 19
Novalux Highway Lighting Unit Showing Nested Parabola Construction and Pole Extension

headlights. While recent improvements in headlamps through the enforced use of proper lenses and sizes of lamps have greatly improved night driving from a safety standpoint, there is still considerable objectionable glare present.

The cause of a large percentage of night fatalities has been the inability of vehicle drivers to perceive pedestrians on the highway at a safe distance to avoid collision.

The increasing number of trucks operated on all night schedule has added another danger to night traffic. They move comparatively slowly and are generally equipped with less efficient headlamps than are passenger cars. This means a general slowing up of the entire traffic along the highway as well as seriously augmenting

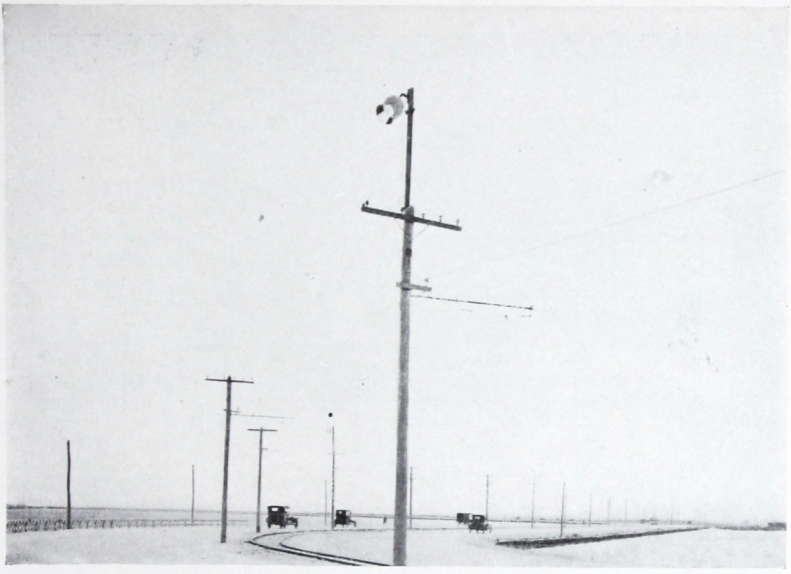

FIG. 20
Day View of an Installation of Novalux Highway Lighting Units on Causeway Between Miami and Miami Beach, Florida. 2500-lumen MAZDA C lamps are used, spaced 300 ft. and mounted 35 ft. high

the possibility of collision. Because of the inadequate illumination afforded by headlights the driver is also likely to strike obstructions or holes and do considerable damage both to the truck and the highway. Quite often the driver, not being able to make out the outline of the road clearly, runs off the roadbed on to the side of the road which being of poorer construction cannot stand the dead weight thrust upon it.

Night traffic is also increased by the large number of passenger busses operating between cities. These are of considerable size and come under the truck classification, although they are essentially

of a higher speed. The seriousness of a collision or accident to a vehicle of this nature would be great and every possible means should be taken for the protection of the traveling public.

Another danger of night driving is present in the form of holdups or robberies. During the last three or four years there has been a great deal of activity along these lines until in certain sections of the country no one stops to render assistance when requested, for fear of being waylaid.

FIG. 21
Night View of Novalux Highway Lighting Installation, Miami, Florida

The severe requirements for highway lighting make it a very difficult problem to solve. One of the most important considerations is cost. It is entirely obvious that as few units as possible should be used and at the same time provide sufficient illumination for safety. There should be such illumination upon the roadway as to enable the driver to see pedestrians or obstacles in his path at a safe distance and the outline of the road at all times. Enough light should be provided as to eliminate, as far as possible, the glare from approaching cars. Dangerous curves, steep grades and narrow bridges to be properly protected at night must be readily visible.

Kind of Unit, Spacing and Mounting Heights

It has been only recently that any improvements have been made in highway lighting to bring up the standards to conform with the exacting requirements. A highway lighting unit, Fig. 18, has been designed by the General Electric Company which gives a very satisfactory illumination for this purpose. This unit which is called the Novalux highway lighting unit is designed especially for use with a 250-candle-power lamp. The light given off by this lamp is collected by two sets of nested parabolic reflectors (Fig. 19) concentrated upon the highway in both directions, no light escaping upward or to the surrounding fields. The efficiency of this unit is so great as to give a very satisfactory driving light with a spacing of 300 feet or 18 to the mile. Spacings as high as 600 feet have been tested but gave less effective illumination even when used with correspondingly higher powered lamps. The unit is mounted on poles along the edge of the highway at a hanging height of at least 35 feet. This height must be used to assure good distribution and to avoid glare. An adjustment of the units may be made to take care of the ordinary variations on pole positions and road curvatures. A modification of the pole type may be obtained by overhead suspension.

Advantages

Extensive demonstrations and installations which are now in use have shown that with the recommended spacing and lamp size the highway is very satisfactorily lighted with rather more illumination than is found on most resident streets in cities. While traveling beneath these units, it is found possible to drive with simply dim lights. With bright headlights the glare is reduced to such an extent as to make driving conditions comfortable and safe. The illuminated road stretches away in front of the car, presenting the appearance of a broad band of light and shows up any objects or irregularities which may be present. Drivers are able to judge distances much more accurately under the well lighted condition. This is conducive to confidence on the driver's part, consequently accelerating general traffic speed. It has also been found that upon a well lighted road there has been practically no trouble caused by criminal activities.

Summary—Street Lighting Practice

Type of Street	Kind of Unit	Size of Lamp		Spacing Ft.	Mounting Height Ft.
		Lumens	C-P.		
Main business section	Ornamental	6000–25000	600–2500	60–150	14–25
Secondary business section	Ornamental	6000–10000	600–1000	100–125	15–20
	Pendant with refractor	6000–10000	600–1000	100–125	20–25
Main thoroughfares	Ornamental	4000– 6000	400– 600	75–150	15–20
	Pendant with refractor	4000– 6000	400– 600	100–200	20–25
Residential	Pendant (at corners)	2500– 6000	250– 600	200–350	15–20
	Pendant (more closely spaced)	1000– 2500	100– 250	100–200	10–18
	Ornamental	1000– 4000	100– 400	100–250	10–16
Parks	Ornamental with refractor	2500– 6000	250– 600	100–200	12–20
Boulevards	Pendant or ornamental (refractors)	4000– 6000	400– 600	100–200	15–20
Outlying suburban section, alleys and side streets	Refractors and radial wave type	1000– 2500	100–250	100–250	15–20
Highways	Novalux highway unit	2500	250	300	35

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